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SCIENCE AND THE NATION[1]

By Sir WILLIAM BRAGG

MANY events conspire to make the past year notable in the history of our society. Reference has been made to the majority of them in the Annual Report of Council, usefully supplemented by the Notes and Records which we continue to owe to our past treasurer, Sir Henry Lyons. I do not propose to speak of them in detail, but on this occasion it does seem fitting to give further attention to one or two general matters of lasting interest.

One of these is personal. Fellows will have noted the long list of those whom we have lost, and the great names which the list contains. I have felt as I have been reading it that I have turned over the last leaves of a chapter that stands by itself. The present generation is quick to honor the names of J. J. Thomson and Oliver Lodge, but they can not remember, as we older men can, the brilliant years when these men and their contemporaries were writing the chapter's first pages. What they wrote was eagerly read, their lectures were rapt attention; they were the pioneers, and the scientists of that time, nearly half a century ago, streamed after them. All that is now a memory. The years have slipped away since their work was done, and we now look back on it and see it as a separate entity, a noble event in the history of science, and of British science in particular.

There is no vestige of sadness in such a retrospect, nor any trace of feeling that our pride must be founded only on what has passed. I am sure that all those who like myself can recall the long years, and compare those that have gone by with those that are still ours, will say happily and proudly that our young men of to-day are maintaining in full force the tradition that they have received. They are writing a new chapter;

[1] Address of the president of the Royal Society at the Anniversary Meeting, November 30, 1940.

and it is a chapter of a novel importance because as they extend our record of the facts of nature they find themselves compelled at the same time to consider a new problem, the relation of those facts to society and to the government of nations. Let me express my admiration of the willingness, vigor and ability with which the newer generation gets to work.

This same novelty is enlarging the range of work of our society and is a second matter to which we are compelled to give serious attention. Our fellows have constantly given their services to public interests; it has often been pointed out that they are to be found in association with almost every department of government. But this year new moves have been made which may, and I hope will, lead to developments of the highest importance. The Report contains a notice of the recent formation of a Scientific Advisory Committee, over which Lord Hankey presides, with a reference which in effect directs it to consider the advances of science in their relation to national welfare. The committee reports to the cabinet through its chairman. A committee of similar nature but lesser scope was set up a few months ago to consider the scientific aspects of the food policy of the government: it consists of well-known authorities on nutrition, agriculture and economy, with myself as chairman. This committee reports to Lord Privy Seal, and so to the Cabinet Food Policy Committee over which Lord Privy Seal presides. The significant feature of these committees is their close and direct association with the cabinet, the central body that governs our nation. Hitherto scientists have been appointed man by man to various government departments so that they might act as useful items in departmental machinery. The new committees are not parts of any executive body and have no executive power of their own. They exist to make recommendations, which must of course be practical and take full account of difficulties of execution. But they are not hampered by traditions, nor by set habits; they have time and freedom to consider the whole field of scientific knowledge and its possible influence on practice. The Scientific Advisory Committee, the more important of the two, is particularly well fitted to watch all occasions and opportunities for the employment of science in the service of the nation, and also for the continuous encouragement of that employment. The president of the society and the two principal secretaries are in close touch with every branch of science; through the fellows of the society which they serve they have a unique view of scientific progress. The three secretaries of the principal research councils of the government, dealing with industry, agriculture and health, are in close touch with the chief national activities.

Thus a great opportunity is opened after long expectation; and the Royal Society is largely responsible for the development of that opportunity. We hope that no hindrances from without may interfere with the society's task, and we are determined that there shall be no lack of energy from within.

We remember that it is science itself, not scientists, that we are trying to lift to the high places. In that respect our movement is not selfish. We do not claim that scientists shall be entrusted with authority because they are scientists: we do claim that authority shall be exercised in the light of a knowledge which grows continuously, and with continual effect on politics, on industry and on thought itself. If at present the only way to bring this knowledge into use is to treat scientists as consultants, let us take that way. But we shall be taking the better way if in all ranks of the state, and especially in those that have authority and set an example, we can arouse a general appreciation of the position, and a constant understanding watchfulness on the increase of knowledge and the uses that are made of it and can be made. It can not be said that the general aspect of the nation towards the increase of knowledge is satisfactory. Science has become an integral part of our educational system, yet the changes that have been made are often ridiculously like the casting of sacrifices to following wolves. Science is not a devouring monster, but a means of service; it is a knowledge, gained by an irresistible tendency of man to examine his surroundings. It may be rightly or wrongly used. There is a prime danger if those who are in the position to use it rightly shut their eyes to its presence and its power, like an army which relies on bows and arrows when its enemies know how to use machine guns.

It is not universally nor even sufficiently understood how important natural knowledge has become. It is true that in a vague way the nation is brought by the happenings of war to guess at the meaning of scientific research in every kind of enterprise. But still it would be difficult for most people to grasp the significance, much less the meaning of the description of a fact like this: that the R.A.F. could not carry out its operations without the knowledge resulting from the studies of cathode-rays and electrons made by our physicists, which is equivalent to saying that by this time we might well have lost the war. Similar cases of cause and consequence could be quoted in numbers; they happen to be found more readily in relation to the sciences that deal with inorganic materials than those that deal with organic processes, and the military demand for physicists has been great because they are wanted to put physical discoveries into practice. But this discrimination is only accidental and temporary, and in fact the whole range of science is equally concerned.

Since experimental science has assumed such a commanding influence on all our affairs, so that we run the risk of great perils if we take no account of it, and leave its uses to others, let us say less well disposed than ourselves, and, on the other hand, have opportunities of great benefit if we use it rightly, it becomes a first duty to direct our steps accordingly. Just as in former times schools and colleges were founded to train men for the service of church and state, in ways which were appropriate to that high end, so now we have to see to it that the men are produced by our educational systems who can appreciate and act up to a new state of affairs. This can be done without jettisoning any of the fine instruction which has been a proud feature of our older systems.

I think that this is not essentially a matter of the rearrangement of school time tables, or the building of scientific laboratories, though such tactical methods must have their due consideration. This is a personal matter, as has been the case with every great human movement. We have not to force the use of new tools, but to encourage and develop a new appreciation and a new attitude. Our best method, as ever before, lies in our own actions. If we, in the continually increasing contacts of scientists with public affairs, can show that we have something of great value to contribute, and that we give it freely, placing our individual interests below those of a greater purpose; if we try to understand the motives and principles of those whom we meet who may not see our vision just as we may fail to appreciate theirs, then by so doing we have the best chance of bringing about the changes that we desire. It is the personal contact of the scientist, especially with those who are charged with duties to the nation, that is the moving force. That is where these new associations of science with government may mean so much, and shall mean it, if our devotion can achieve its purpose.

This afternoon I leave the presidential chair. I have deeply appreciated the honor that has been paid to me by my election to it, and I want to thank with all my heart the officers of the society, the members of council and the permanent officials who have helped me to fulfil its duties.

THE ROYAL SOCIETY[1]

By Dr. L. J. HENDERSON

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THE purpose of the "Record of the Royal Society" is "to provide a compendium of information, largely historical, regarding the rise and progress, the organization and work of the Royal Society." This purpose is admirably achieved in the present revised and enlarged fourth edition of the work. The book comprises a brief history of the society, notes on the charters and statutes, full information about the benefactors of the society, its funds, research professorships, fellowships and studentships, its library, portraits, busts and other property, its committees, publications and relations with the government. In appendices the various charters and statutes of the society are printed and also complete lists of patrons and officers, of medalists and lecturers and finally of fellows arranged both chronologically and alphabetically. Accordingly, this is both a book of reference and an account, brief, but documented as few histories can be documented, of the formation, the development and the functions of a national academy of science.

The Royal Society of London for the Promotion of Natural Knowledge is in many respects the most interesting of all such academies. It is the oldest surviving academy that has had a continuous existence. In the second half of the seventeenth century it was one of three which accomplished the first effective organization of scientific work and of scientific workers, and to-day, though its activities are different from its early activities, they are still as important as ever to the sciences and probably much more important—at least directly—to the state and to society at large.

It is convenient to divide the history of the Royal Society into three periods: the seventeenth century, the next century and a half, and lastly the time from the middle of the nineteenth century to the present day. On the whole, the composition of the society, its activities and its functions have varied widely in these three periods. The first and third are the times of vigorous activity.

The present "Record" begins with the statement that "the foundation of the Royal Society was one of the earliest practical fruits of the philosophical labours of Francis Bacon," and so it was in a measure that is to-day hardly appreciated. Sprat may be cited in support of this judgment. He wrote in his "History of the Royal Society" in 1667:[2]

[1] "The Record of the Royal Society of London for the Promotion of Natural Knowledge." Fourth edition, London, printed for the Royal Society by Morrison and Gibb, Ltd., Edinburgh. 1940. Price, 21/-.

[2] Tho. Sprat, "The History of the Royal Society of London, For the Improving of Natural Knowledge," London, 1667, pp. 35–36.

In [Bacon's] Books there are every where scattered the best arguments, that can be produc'd for the defence of Experimental Philosophy; and the best directions, that are needful to promote it. All which he has already adorn'd with so much Art; that if my desires could have prevail'd with some excellent Friends of mine, who engag'd me to this Work: there should have been no other Preface to the *History* of the *Royal Society*, but some of his Writings.

Yet after much further discriminating praise Sprat goes on to remark:

But yet his *Philosophical Works* do shew, that a single, and busie hand can never grasp all this whole Design, of which we treat. His Rules were admirable: yet his *History* not so faithful, as might have been wish'd in many places, he seems rather to take all that comes, then to choose; and to heap, rather, then to register.

So it is evident that the movement of thought in England had already discriminated between the best of Bacon's ideas and the rest of them. There must have been wide consideration and discussion of these ideas, for the "New Atlantis," first published in 1627, had appeared in ten editions forty-three years later.

Men banded themselves together in England, as in Italy and France, at this time not only under the influence of ideas but also under the influence of real needs. Association is necessary for the transmission of skills, prompt information about the work of others is necessary to men who are studying natural phenomena, in the absence of journals correspondence carried on as effectively as possible is widely called for, and all this gives rise to spontaneous association and to a recognition of the importance of corporate action. Ingenious men quickly recognize and strongly feel such needs. Boyle, Wilkins, Wallis, Evelyn, Hooke, Wren and Petty, different as they were, were all clearly moved in such ways, and there were many others.

The first gatherings out of which the society finally arose were spontaneous and seem to have originated in the forties. There was certainly a meeting in London at Gresham College as early as 1645, and Boyle's first famous reference to the "invisible college" is of 22 October, 1646. This was a time of trouble when men were disturbed, much as they are to-day, and there is evidence that the founders resorted to these early meetings as a release from the troubles of the times. Sprat says:[3]

Their first purpose was no more, then onely the satisfaction of breathing a freer air, and of conversing in quiet one with another, without being ingag'd in the passions, and madness of that dismal Age. And from the Institution of that *Assembly*, it had been enough, if no other advantage had come, but this: That by this means there was a race of yong Men provided, against the next Age, whose minds receiving from them, their first Impressions of *sober* and *generous knowledge*, were invincibly arm'd against all the inchantments of *Enthusiasm*.

It is not too much to see in the last phrase of this quotation another influence of Bacon through his discussion of Idols.

About 1648 or '49 the original band of the "invisible college" became divided between Oxford and London, and for a time the greatest activity was at Oxford. The design for the Royal Society was probably debated for the first time only six months after the return of Charles II, on 28 November, 1660. Its execution was promoted especially by Sir Robert Moray, a man who was president before the incorporation of the society and whose influence with the King seems to have been decisive. The first charter is of 15 July, 1662, and the president of the newly incorporated society was Lord Brouncker. The first council included also Sir Robert Moray and all the men above mentioned except only Hooke (*b.* 1635), who in November was appointed curator of experiments to the society. A second charter, providing all desired privileges, is of 22 April, 1663; a third, of no great importance, of 1669. The famous mace, a gift from the King, was ordered on 23 May, 1663. There were 119 original fellows, of whom not more than a third were men of science, the rest noblemen and gentlemen of substance and importance whose support was needed and whose concern for the society seems to have been frequently greater than that of their successors in the eighteenth century. Among the original fellows was John Winthrop, Governor of Connecticut.

Another original fellow was John Graunt, author, probably with Petty, of the "Natural and Political Observations on the Bills of Mortality." This work interested the King, who recommended[4] the election of its "judicious author . . . in whose election it was so far from being a prejudice that he was a shopkeeper of London, that his Majesty gave this particular charge to his Society, that if they found any more such tradesmen, they should be sure to admit them all without any more ado."

The early meetings of the society were devoted mainly to the demonstration of experiments, and there are records of hundreds of experiments performed by Hooke and later by the joint curator, Papin, appointed to the post in 1684. The society further showed its interest in experimentation by procuring the publication of an English translation of the famous work on experimentation that had been put out by the Accademia del Cimento of Florence.[5] But the Royal

[3] *Ibid.*, p. 53.

[4] "Record of the Royal Society," 4th ed., p. 20.

[5] Essays of Natural Experiments Made in the *Accademia del Cimento*, under the Protection of the Most Serene Prince *Leopold of Tuscany. Written in* Italian *by the Secretary of that* Academy. Englished by *Richard Waller*, Fellow of the *Royal Society, London*, 1684.

Society never went as far as the Cimento in excluding speculation. The subjects of both experiments and papers during the early years of the society were extremely varied. There was much that was important and also much that was trivial. This may be attributed to the undifferentiated nature of the science of that day, to the freshness and curiosity of the spirit of the seventeenth century "Virtuosi," and to the strong interest of many of the founders of the society in the applications of science and in *useful* knowledge. This, again, is perhaps partly owing to the influence of Bacon.

The voluminous correspondence of the society, conducted by the industrious secretary, Oldenburg, was also an important feature of the meetings. This work of Oldenburg's led to an incident which once more suggests present conditions. He was born at Bremen, and in 1667 was arrested on suspicion of carrying on with foreigners political correspondence not to the liking of the King and the government. For some time he was imprisoned in the Tower of London. This event may have been responsible for the suspension of meetings of the society from the end of May to the beginning of October. The *Philosophical Transactions* were begun by Oldenburg within three years of the granting of the first charter of the society.

In its early years the society also gave the support of its imprimatur to the publication of numerous important books, including works by Evelyn, Hooke, Graunt, Malpighi, Wallis, Willughby, Grew, Lister, Ray, Flamsteed and Papin, and most important of all, Newton's "Philosophiae Naturalis Principia Mathematica." The society also procured the writing and publication of Sprat's "History of the Royal Society."

In early years a Repository of Rarities was built up. This later (1781) was turned over to the British Museum, which had originated in the famous collection of Sir Hans Sloane, president of the Royal Society from 1727 to 1741. The long and intimate connection of the society with the Royal Observatory at Greenwich is also of early origin. From an early date also, committees of the society took over work not unlike that performed by committees of the present day.

In the beginning the society seems to have been, on the whole, favorably regarded, though Sprat's "History" is in part a defense against the old philosophy. The poets Dryden, an original fellow, and Cowley, whose name appears on the first list of those from whom the Royal Society originated, were actively favorable; but later and for a long time there was much hostility and ridicule from men of letters, such as Addison, Swift and Pope. In attacking French academicians Voltaire was an imitator of Swift.

During the seventeenth century there were also signs of anxiety about the conflict of theology and science. The question is taken up in the "History" by Bishop Sprat, who carefully develops the thesis that there ought to be no conflict, and it may be presumed that concern for this danger led the pious Boyle to found the Boyle Lectureship, which still continues. This was the time when Evelyn published an English translation of Book I of Lucretius's *De Rerum Natura*, for which he was privately reprimanded[6] by Jeremy Taylor, and it seems nearly certain that Lucretius was then exercising great influence upon thought and that this was in part the cause of the anxiety of men like Sprat and Boyle.

During the seventeenth century and for a long time thereafter, universities were not on the whole favorable to the development of science. This fact is well illustrated by a letter of Newton's written from Cambridge on 23 February, 1684–85. Newton says:[7]

> The designe of a Philosophical Meeting here, Mr. Paget, when last with us, pusht forward, and I concurred with him, and engaged Dr. More to be of it; and others were spoke to partly by me, partly by Mr. Charles Montague; but that which chiefly dasht the business, was the want of persons willing to try experiments, . . .

It is all the more remarkable that even in the earliest years of the society a sound understanding of effective scientific procedure is both implicit in the works of the founders of the Royal Society and even clearly formulated by Hooke in his *Micrographia* (1665):[8]

> So many are the *links*, upon which the true Philosophy depends, of which, if any one be *loose*, or *weak*, the whole *chain* is in danger of being dissolv'd; it is to *begin* with the Hands and Eyes, and to *proceed* on through the Memory, to be *continued* by the Reason; nor is it to stop there, but to *come about* to the Hands and Eyes again, and so, by a *continual passage round* from one Faculty to another, it is to be maintained in life and strength, as much as the body of man is by the *circulation* of the blood through the several parts of the body, the Arms, the Feet, the Lungs, the Heart, and the Head.

Newton was president from 1703 until his death in 1727, but already the ardor of the early years of the society had cooled and there followed a long period that is relatively unimportant. During this period the proportion of men of science among the fellows was always small, and on the whole men of great scientific distinction were few. Notable exceptions in the eighteenth century were Hales, Bradley, Cavendish, Watt, Priestley, the elder Herschel, John Hunter and two Americans, Franklin and Rumford, whose initiative, versatility and practical abilities remind one of Wren and Petty rather than of their own eight-

6 Letter, 16 April, 1656.

7 C. R. Weld, "A History of the Royal Society," London, 1848, Vol. 1, p. 305.

8 Preface.

eenth century English contemporaries. Possibly there is some significance for the social historian in the origin of such men in the later period and in a remote colony.

In the second half of the eighteenth century the government began to make a practice, which has become highly important, of referring scientific questions to the Council of the Royal Society for consideration and advice. One early question gave rise to a famous controversy concerning lightning rods, and in the year 1777 the affair degenerated into a political quarrel. Pointed lightning rods were the invention of Franklin, who had become a rebel. Benjamin Wilson advocated blunted conductors, and the partisans of pointed conductors were regarded as friends and supporters of the Americans. The affair seems to have resulted finally in the resignation of the president, Sir John Pringle, who had said to the King in supporting pointed rods: "I cannot reverse the laws and operations of nature." There is a story, not well founded but widely believed, that the King replied: "Perhaps, Sir John, you had better resign." At all events, Pringle did resign and was succeeded by Sir Joseph Banks, whose long presidency, in some respects almost monarchical, continued from 1778 to 1820.

Earlier in the lightning rod controversy, the council found it necessary to take the position that the society as a whole did not give an opinion, but that:[9]

> The procedure was that a Committee of the most eminent of the Fellows of the Society cognizant of the subjects concerned was appointed by the Council, and their report when adopted by the Council was transmitted as their recommendation. This procedure has always been observed and is still in use.

Judging by long experience, such a practice seems to-day necessary, alike in the interest of the society and of the state. In the long run it may well be an indispensable condition for the independence of an academy of science, for it is competent individuals, not societies, who can objectively weigh and appraise evidence.

A further development was the appointment of fellows of the society by departments of the state to serve on councils and committees where scientific matters must be considered or reviewed. In more recent years such activities of the society and of its members have taken on the very greatest importance.

The Linnean Society was founded in 1788, the Geological Society in 1807, the Astronomical Society in 1820. At first these new societies were regarded as secessions from the Royal Society and were strongly opposed by Sir Joseph Banks. In due course, however, it became clear that this movement, like the establishment of journals devoted to specialties, was indispensable and that it did not lead to a weakening of the Royal Society but only to a modification, and in some respects to a strengthening, of its activities.

In 1743 a dining club was established among the fellows, which since 1795 has been known as the Royal Society Club. This club survives in full activity. It has had its ups and downs, and from 1847 for some decades its functions were in part usurped by the Philosophical Club, made up of a body of reformers. Long before the end of the nineteenth century, these reformers had accomplished their purpose, and in 1901 the two clubs were amalgamated.

The early years of the nineteenth century were a period of transition marked by not a little dissatisfaction among the scientific fellows of the society. In the year 1830, "Of the 662 Fellows who then formed the Society only 104 had contributed at least one communication which had been published in the 'Philosophical Transactions.'" It was in this year that Babbage published his "Decline of the State of Science in England," which was chiefly directed against the Royal Society. He had been associated with Peacock and the younger Herschel in an attempt to introduce Continental mathematics into the University of Cambridge, one of his efforts having been the proposal to form a society for promoting "the Principles of pure *d*'ism [*d* is Leibniz's symbol] in opposition to the *dot*-age of the university [*dots* are Newton's notation]." It was also in this year that a serious effort, in which Faraday seems to have taken a hand, was made to elect Herschel president, but in the end the Duke of Sussex received 119 votes and Herschel 111.

At length, in 1846, it was decided:[10]

> . . . that the election of candidates for the Fellowship should be held once annually and in May; that the number which the Council should select and recommend for action each year should not exceed fifteen.

It is said that:

> This was probably one of the most important, if not the most important, change in the administration of the Society which had been made since its foundation, for the result was to change it within a generation from a body of well-educated and cultivated men, of whom probably only one-third or rather more could be classed as men of science, to a scientific institution of the highest rank.

The number 15 was adhered to until 1930. From 1930–37 the number of candidates elected on the recommendation of the council was 17. Since 1937 it has been 20.

This action has had a marked effect not only upon the choice of candidates but upon the size of the so-

[9] "Record of the Royal Society," 4th ed., p. 47.

[10] *Ibid.*, p. 58.

ciety. From the year 1700 until about 1850 the increase in the number of fellows, almost linear, was from just over 100 to more than 750. During the ensuing 30 years the number fell continuously to less than 500. Since that time it has always been between the limits 450 and 500.

The ratio of this number to the number of inhabitants of the country is greater than 1/100,000. The corresponding ratio for the United States is less than 1/300,000. Indeed, the fellows of the Royal Society are somewhat more numerous than the members of the National Academy of Sciences, and are likely to become even more so. Such differences between the two bodies can hardly lack importance. It must be remarked, however, that other circumstances, such as habits and traditions and the possible frequency of meetings, may well go far to determine the optimum size of an academy. At all events, it may be said that a membership of the Royal Society both relatively and absolutely large has proved to be advantageous. On the other hand, the Académie des Sciences of the Institut de France is both relatively small and absolutely very small indeed, and this is rather widely regarded both in France and elsewhere as a disadvantage. Yet a century ago it was perhaps not so regarded.

Like all other academies whose members are chosen from the whole field of science, the Royal Society is troubled by the problem of making its ordinary meetings generally interesting. This is a difficulty which hardly existed in the early years of the society, but which arose long ago with the increasing specialization of men of science and which seems likely to continue. It rests upon the awkward fact that there is little satisfaction in listening to a paper that you do not understand on a subject in which you are not interested. In respect of this difficulty, the small extent of the country and the possibility of frequent meeting are perhaps disadvantages.

The present state of the society is well known and is fully documented in the present "Record." The Royal Society has become a central body of men of science, long since relieved of the tasks that have been taken over by the many special scientific societies, charged with many responsibilities but detached from politics and from special interests of all kinds. The duties of the society as the established and traditional adviser of the government on all scientific questions have steadily increased. Its concern for international affairs, at least in times of peace, has greatly developed, and during the present century new responsibilities in the administration of funds for research have arisen. In the year 1900 the value of the research funds of the society was £42,000; in 1937 it had grown to £636,000. There are now six research professorships financed by the council of the society and also a number of research fellowships and studentships.

To-day the Royal Society is an indispensable and efficient part of the organization of a complex modern state. To what does it owe its strength and its usefulness? First, it is a truly representative body. For nearly a century the council has in fact had the last word in the selection of new fellows. Of late years the practice has been that special committees sift the candidates, but the council still makes the final selection and is said to determine a certain small proportion of the nominations independently of all committees. Thus the council can see to it that all subjects are fairly represented in the membership of the society and that men whose work falls outside the recognized special sciences are not forgotten. There is perhaps no really good way of recruiting an academy, and under any system some men are bound to be overlooked or rejected until they have passed their prime. But the system of election to the Royal Society has long worked well and the highest scientific competency of the nation is always well represented in the Royal Society.

Secondly, the council is also charged with almost all administrative and executive duties and authority. It is a working body, a body small enough for effective deliberation which can meet frequently and which, partly for that reason, possesses and preserves a tradition of responsibility. This condition, to be sure, also depends upon the smallness of the country and upon the fact that in general the members of the council live in or near London. In particular, Cambridge is not far from London, and the importance of Trinity College, Cambridge, in the activities of the Royal Society is very noteworthy. During the present century more than half the presidents of the Royal Society—the elder Rayleigh, J. J. Thomson, Rutherford, Hopkins and W. H. Bragg—have been fellows of Trinity, and during the same period more than one third of all officers of the society have been fellows or scholars of the same college.

Thirdly, the society is respected. Englishmen at large think of it as a great national institution, and they think of it often. It is kept before their minds by its many important public services, by the dignity of its ancient establishment and honorable record, and even perhaps by the magic of the familiar letters F.R.S. All young men of science aspire to membership. In England this is a strong and conscious ambition among the young men, an ambition probably much more general, stronger and more conscious than the ambition of young Americans to become members of the National Academy of Sciences. Such ambition is a source of strength to the society and to science in general.

Above all, the Royal Society is independent. Thus

it can freely promote natural knowledge and fearlessly, without prejudice, select committees qualified to give expert advice and opinions and able to do so disinterestedly. Not very long ago such freedom and independence were taken for granted. But a time has now come when we may well ponder them. By studying the Royal Society as described in its official "Record," much may be learned of the conditions governing the effective organization of men of science and their disinterested service to society.

OBITUARY

CARL L. ALSBERG

THE passing of Carl L. Alsberg on October 31, 1940, represents indeed a loss, not only to the world of science, but even more so to those who had the privilege of knowing and working with him. That his loss will be felt in many different quarters is due, in large part, to the extraordinary breadth of his interests and an all-embracing curiosity which led him into ever newer fields. His life was one of many transitions and to each new task he brought, not only the wealth of great experience, but also a rare originality of thought and quickness of perception.

Born in New York City in 1877, his early education was not along conventional lines but took place entirely at home under the supervision of his mother, a woman of unusual intelligence, and his father, who was a chemist. While still quite young, he entered Columbia University, from which he obtained an A.B. degree at the age of nineteen. His early interest was in biochemistry, probably traceable to the influence of his father, and as training for his chosen field he studied medicine, taking an M.D. degree from Columbia in 1900. Thereafter followed three years of scientific study and research at the Universities of Strassburg and Berlin, and upon his return to the United States he was appointed assistant in physical chemistry at Harvard University. His association with that institution in various capacities lasted until 1908, at which time he entered the service of the Bureau of Plant Industry in the United States Department of Agriculture as chemical biologist. In 1912 he was selected to head the Bureau of Chemistry in the Department of Agriculture and served as bureau chief for nine years, during which time he developed a keen interest in problems of governmental policy and administration.

On the founding of the Food Research Institute at Stanford University in 1921, he accepted appointment as one of the three original directors, his fellow directors being Dr. Alonzo Taylor and Dr. Joseph S. Davis. With his removal to the West Coast, Dr. Alsberg soon became deeply interested in problems of the Pacific area, in particular those of food supply and their effect upon the population of the Far East and North America. The result was his very active participation in the Institute of Pacific Relations, and for years he served, not only as trustee, but also as chairman of the International Research Committee of that body. He was, in addition, a member of the Committee on Pacific Investigations, Division of Foreign Relations, of the National Research Council, and a member of the Pacific Coast Regional Committee of the Social Science Research Council.

It was at the Food Research Institute that Dr. Alsberg first took an active interest in economics, an interest stimulated by his close association with others concerned primarily with the economics of food supply. As a result, his energies were given a new direction, to which a lengthy list of publications on various economic phases of the food industry can attest. He was in particular attracted by problems of food production and commodity regulation, and in recent years devoted much time to the study of these questions in relation to wheat and fats and oils.

On the whole, the years at Stanford represented a transition between the natural scientist and the social scientist, and with his appointment in 1938 as director of the Giannini Foundation and professor of agricultural economics at the University of California, this new development was completed. Due to his own experience, Dr. Alsberg was always deeply concerned with the relationship between the physical and the social sciences. His years of service to the former had confirmed his belief in the great worth of the natural sciences, not only *per se*, but as a discipline for the scholar. He was especially fascinated by the problem of adapting the methods of research employed in the natural sciences to research in the social sciences and emphasized the value of scientific methods in his teaching.

To give a list of Dr. Alsberg's publications and the many organizations in which he was active would require much space. Above all, it would give no genuine picture of his truly great contribution to science and to society, for much of this lies hidden in the encouragement and stimulus he has given to others. Never one to be sparing of his help, his suggestions and advice have led to the inauguration and completion of many works of scholarship and research, and even invention, which otherwise might not have seen the light of day. For this he claimed no credit but the satisfaction of seeing a good piece of work well done.

His influence will live long after him in those who knew him.

EDWIN C. VOORHIES

THE GIANNINI FOUNDATION OF
AGRICULTURAL ECONOMICS,
UNIVERSITY OF CALIFORNIA

RECENT DEATHS

DR. WILLIAM JULIAN ALBERT BLISS, from 1901 until his retirement in 1928 with the title professor emeritus, collegiate professor of physics at the Johns Hopkins University, died on December 27 in his seventy-fourth year.

ROY BURNETT SMITH, professor emeritus of chemistry at Colgate University, a member of the faculty for 37 years, died on December 25. He was sixty-five years old.

DR. JOHN EARL GUBERLET, professor of zoology and member of the staff of the Oceanographic Laboratories of the University of Washington, died on December 30 in his fifty-fourth year.

DR. WILLIAM BROWNING, emeritus professor of neurology of the Long Island College of Medicine, died on January 5 in his eighty-sixth year.

DR. CLELIA DUEL MOSHER, emeritus professor of hygiene at Stanford University, died on December 22 at the age of seventy-seven years.

HENRI BERGSON, professor of philosophy at the College of France from 1900 to 1921, died on January 4 at the age of eighty-one years.

JACQUES ARSÈNE D'ARSONVAL, professor emeritus of experimental physiology at the Sorbonne, Paris, died on December 31 at the age of eighty-nine years.

Nature reports the death of Professor Emile Argand, professor of geology, mineralogy and paleontology in the University of Neuchâtel, at the age of sixty-two years, and of Dr. Wilhelm Haberling, professor of the history of medicine in the Düsseldorf Academy of Medicine, at the age of seventy years.

PROFESSOR E. O. ESSIG writes: "The date of birth of Professor Charles William Woodworth has been erroneously given as April 8, 1865, in 'American Men of Science,' ed. 6, p. 1575, 1938; 'A History of Entomology,' Macmillan Co., N. Y., p. 800, 1931, and SCIENCE, Vol. 92, p. 570, 1940. The correct date is April 28, 1865."

SCIENTIFIC EVENTS

RESEARCH IN THE FIELD OF PHARMACOPOEIAL REVISION

DURING the Pharmacopoeial Convention last May, a request was presented for the publication from time to time of research problems, which, if solved, would assist in the work of revision. To comply with this request the chairman of sub-committees have been requested to suggest subjects which in their special fields were particularly important. More detail will be given to any one who is interested in investigating one of the subjects suggested.

The following subjects have been offered:

A method for biological assay of Ergot that measures the content of both Ergotoxine and Ergonovine types of alkaloids.

An efficient and inexpensive method for biological assay of Aconite and its preparations.

Statistical studies of the value of Anti-pneumococcic Serums in general practice.

A suitable standard of assay for Rheum based upon its Anthraquinone content.

The comparative anatomy of the rhizomes and roots of Chinese Rhubarbs yielded by *Rheum officinale, R. palmatum, R. palmatum* var. *tanguticum* and hybrids between these and other Rheum species including *R. Rhaponticum.*

Further studies of the assays of Cantharidies, Ipecac and Capsicum.

Chemical assay of Aconite and Aloe.

The separation of Strychnine and Brucine.

The therapeutic value of reduced iron.

The absorption of pure powdered electrolytic iron from the alimentary tract.

Rapid, accurate method for the determination of the pH of distilled water.

Further study of the limit of unsaturates test in Cyclopropane.

Heavy metals' test for Diluted Hypophosphorous Acid.

The sensitivity of the flame test for sodium in chemicals used as reagents.

Oil of Cassia, tests and constants.

Oil of Nutmeg, detection of Pinene or redistilled Oil of Turpentine.

Oil of Peppermint, tests and constants (distinction between unrectified and rectified).

Stability of Fluidextract of Ergot.

Tincture of Digitalis. A study of the U.S.P. Tincture and a comparison of the tincture made from defatted drug to determine the difference, if any, in activity.

A cytogenetical study of *Rheum officinale, Rheum palmatum* and other Asiatic Rhubarbs.

A cytogenetical study of *Digitalis purpurea.*

TRAINING AT THE NEW YORK UNIVERSITY FOR SQUADRON ENGINEERING OFFICERS FOR THE AIR CORPS

THE College of Engineering of New York University will train fifty men every three months as Air Corps squadron engineering officers, beginning on

January 7, under a direct contract with the United States Army Air Corps. The College of Engineering is the only institution in the East selected by the Army for this training program.

The men chosen will receive twelve weeks of instruction in engineering theory pertaining to the maintenance of aircraft, after which they will attend the Air Corps Technical School, Chanute Field, Rantoul, Illinois, for approximately six months. Upon the successful completion of the program the men will be commissioned as second lieutenants in the Air Reserve, and will be assigned to tactical units of the Army Air Corps.

Applicants for this course must meet the general requirements for appointment as flying cadets. First priority candidates must be college graduates with degrees in engineering, while candidates with senior standing in engineering colleges will be eligible in second priority.

Squadron Engineering Officers previously have been selected from the pilot personnel of the Army. The rapid expansion of the Air Corps, however, has made necessary the training of new men for these positions. It is planned to provide approximately 400 new officers through this program.

The course of instruction will cover thirty-five hours a week and will include courses in the fundamentals of aerodynamics, airplane design, airplane engines and installation, airplane-engines laboratory, airplane stress analysis, structures and aerodynamics of military planes, aircraft instruments, materials and methods of aircraft construction, propeller design and aircraft detail design.

Although the training of these officers includes no pilot instruction the status, as well as pay and allowances, will be the same as for cadets receiving pilot training. They will be designated as "Flying Cadets." Students having completed the Civil Aeronautics Flight Training Program are especially acceptable for this new instruction. The duties of the men upon completion of the program will consist of field work in charge of mechanics in maintenance and repairs.

Applications for the course may be made at the office of Captain Herbert Kamsler, Room 802, Whitehall Street. Information is also available at the College of Engineering of New York University at University Heights in the office of Professor James M. Coburn.

NEW MEDICAL JOURNALS

BEGINNING in January, the American Medical Association will publish a new bi-monthly periodical: *War Medicine,* as a part of its contribution to the preparedness program. The editorial board will be the Committee on Information of the Division of Medical Sciences of the National Research Council. This committee includes Dr. Morris Fishbein, editor of the *Journal,* as chairman, and the following associate editors: J. R. Bloomfield and Drs. John F. Fulton, Richard M. Hewitt, Ira V. Hiscock, Sanford V. Larkey and Robert N. Nye. In order to have direct cooperation with the governmental services, the following representatives of the Army and Navy Medical Corps and the United States Public Health Service have been chosen to cooperate with this editorial board: Colonel C. C. Hillman, Commander Charles S. Stephenson and Dr. R. R. Spencer. The Division of Medical Sciences of the National Research Council has developed a number of scientific committees which are actively at work preparing reports of various phases of medical service under military conditions. These official documents will be available to the new periodical for prompt publication.

THE Association for the Study of Internal Secretions plans to publish a new monthly journal, *The Journal of Clinical Endocrinology,* the first issue of which is expected to appear on January 10. It is stated that the present journal issued by the association, *Endocrinology,* and the new journal will have the same editorial management, with separate editorial boards. The editorial committee of the new journal includes Drs. Fuller Albright, J. S. L. Browne, E. C. Hamblen, E. L. Sevringhaus and K. W. Thompson.

THE Committee on Research in Medical Economics, of which Dr. Michael M. Davis, of New York City, is chairman, will establish a new journal entitled *Medical Care,* which is planned as a forum of signed expressions of opinion by individuals or agencies. It will make non-technical reports of scientific studies of the medical, administrative and financial experience of plans of organized medical care in the United States; news of the field, and summaries of reports appearing elsewhere. Members of the editorial board are: Dr. Ernst P. Boas, New York City; Dr. Samuel Bradbury, Philadelphia; Claude W. Munger, New York City; Dr. John P. Peters and Dr. C.-E. A. Winslow, New Haven; Dr. Herbert E. Phillips, Illinois; Dr. Kingsley Roberts, and George Soule, economist, New York City.

THE NEW YORK ACADEMY OF MEDICINE

THE inaugural address of Dr. Malcolm Goodridge, who was recently reelected president of the New York Academy of Medicine, was delivered on January 2. The address was entitled "What is the New York Academy of Medicine?"

In it he called attention to a committee of academy fellows which was formed early in the past year to raise the necessary funds to permit the work of the academy to go forward and later to add to the endowment. A five-year plan was adopted under which it

is sought to raise the sum of $550,000 for structural changes in the library and for support of the annual budget. During this five-year period, it is hoped to increase the endowment fund by $1,250,000 so that there may be no interruption in the activities of the academy.

Dr. Goodridge in his address reviewed the work of the academy, including its relation to organized medicine, public health, blood transfusion, medical education and information, and of its standing committees.

Special stress was placed on the services of the library. Dr. Goodridge stated that it is regarded by the Public Library of New York City as the natural repository of medical books, and that it is particularly rich in books on medical biography and the history of medicine. In 1939 it served more than six times as many readers as any other medical library in the country, and of these readers 87 per cent. were not fellows of the academy.

Through the inter-library loan service 3,040 volumes were loaned to 156 libraries in 1939 at an actual cost to the academy of $1,520, while seven volumes only were borrowed by the academy for the use of its fellows at a cost of three dollars and a half.

The bibliographical service furnished by the library is one of three such medical services in this country. The fees charged do not nearly cover the cost.

The library possesses a portrait catalogue, with some 47,000 cards, representing 86,000 portraits of 30,000 individuals. This list is in constant use. Reproduction of library material by photograph, photostat and microfilm served 1,381 clients in 1939.

The Union List of Serials contains the periodical holdings of hundreds of libraries in the United States and Canada, and up to 1925 it contained 75,000 entries. Since 1930, there has been an annual supplement published quarterly. The cost of the original list was $70,000, of which the academy paid $1,800, in addition to the cost, $2,850, of listing its holdings, and about $500 a year is contributed toward meeting the cost of the annual supplement.

Duplicates have been given to libraries in other countries—to Japan, in 1924, to replace losses due to the earthquake; to China, from 1932 to 1940, to replace losses due to the Japanese invasion; to Hungary; to Fiji and to Chile. In 1939 through the Exchange Service of the Medical Library Association 19,834 duplicates were supplied to 272 libraries in the United States and Canada. The cost of handling this material was carried by the academy, for the benefit of other libraries.

In addition the library has a collection of hospital and health reports, medical school announcements and medical government documents from all over the world that is second to none in the country.

OFFICERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A FULL account of the Philadelphia meeting of the American Association for the Advancement of Science and the scientific societies associated with it, edited by the permanent secretary, will be printed in the issue of SCIENCE for February 7.

Officers for 1941 were elected as follows:

President: Irving Langmuir, General Electric Company, Schenectady, N. Y.

General Secretary: Otis W. Caldwell, Boyce Thompson Institute for Plant Research, Yonkers, N. Y.

Permanent Secretary: F. R. Moulton, Smithsonian Institution Building, Washington, D. C.

Treasurer: Carroll Wilson Morgan, Washington, D. C.

Assistant Secretary: Sam Woodley, Smithsonian Institution Building, Washington, D. C.

Vice-presidents of the Association and Chairmen of the Sections:

Mathematics: (A), G. T. Whyburn, University of Virginia.

Physics: (B), R. C. Tolman, California Institute of Technology.

Chemistry: (C), Edward A. Doisy, St. Louis University.

Astronomy: (D), Edwin P. Hubble, Mount Wilson Observatory, Pasadena, Calif.

Geology and Geography: (E), M. M. Leighton, Illinois Geological Survey, Champaign, Ill.

Zoological Sciences: (F), Caswell Grave, Washington University.

Botanical Sciences: (G), Gilbert M. Smith, Stanford University.

Anthropology: (H), George C. Vaillant, American Museum of Natural History, New York, N. Y.

Psychology: (I), E. C. Conklin, Indiana University.

Social and Economic Sciences: (K), Lawrence K. Frank, Josiah Macy, Jr., Foundation, New York, N. Y.

Historical and Philological Sciences: (L), Joseph Mayer, Wheaton College, Norton, Mass.

Medical Sciences: (N), E. W. Goodpasture, Vanderbilt University.

Agriculture: (O), Richard Bradfield, Cornell University.

Education: (Q), Harold F. Clark, Teachers College, Columbia University.

Secretaries of the Sections:

Mathematics: Dunham Jackson, University of Minnesota.

Physics: Henry A. Barton, American Institute of Physics, New York City.

Chemistry: Neil E. Gordon, Central College, Fayette, Mo.

Astronomy: C. C. Wylie, University of Iowa.

Geology and Geography: A. C. Swinnerton, Antioch College.

Zoological Sciences: J. W. Buchanan, Northwestern University.

Botanical Sciences: G. W. Martin, University of Iowa.

Anthropology: W. M. Krogman, University of Chicago.

Psychology: A. W. Melton, University of Missouri.
Social and Economic Sciences: E. P. Hutchinson, Harvard University.
Historical and Philological Sciences: Dorothy Stimson, Goucher College.
Medical Sciences: Malcolm H. Soule, University of Michigan.
Agriculture: M. F. Morgan, Connecticut Agricultural Experiment Station, New Haven, Conn.
Education: H. H. Remmers, Purdue University.

Members of the Sectional Committees:

Mathematics: C. C. MacDuffee, University of Wisconsin.
Physics: H. D. Smyth, Princeton University.
Chemistry: W. A. Noyes, Jr., University of Rochester.
Geology and Geography: Arthur C. Bevan, Virginia Geological Survey, Charlottesville, Va.
Zoological Sciences: G. Fankhauser, Princeton University.
Botanical Sciences: R. E. Cleland, Indiana University.
Anthropology: Ralph Linton, Columbia University.
Psychology: Edna Heidbreder, Wellesley College.
Social and Economic Sciences: Kimball Young, Queen's College (Flushing).
Historical and Philological Sciences: George Sarton, Harvard University.
Medical Sciences: Shields Warren, Harvard Medical School.
Agriculture: Firman E. Bear, Rutgers University.
Education: M. R. Trabue, Pennsylvania State College.
Members of the Executive Committee: J. W. Barker, Columbia University; Walter B. Cannon, Harvard Medical School.
Elected Members of the Council: F. C. Whitmore, Pennsylvania State College; A. F. Woods, U. S. Department of Agriculture, Washington, D. C.
Members of the Grants Committee: W. S. Hunter, Brown University; A. H. Schultz, the Johns Hopkins University.
Member of the Finance Committee: Hayden B. Harris, Washington, D. C.
Nomination to the Board of Trustees of Science Service: Henry B. Ward, University of Illinois.

SCIENTIFIC NOTES AND NEWS

THE Perkin Medal of the Society of Chemical Industry for 1941 will be presented on January 10 to Dr. John Van Nostrand Dorr at a meeting at the Chemists' Club, New York, of a joint meeting of the New York Section of the American Chemical Society, the American Institute of Chemical Engineers, the Electrochemical Society and the Société de Chimie Industrielle, over which Lincoln T. Work will preside. G. H. Dorr, Dr. Dorr's brother, will talk of the personal side of the medallist; Professor Milton C. Whitaker will speak of his scientific accomplishments, and Professor Marston T. Bogert will present the medal, after which Dr. Dorr will deliver the medal address.

THE presentation of the Edison Medal of the American Institute of Electrical Engineers will be made on January 29 to G. A. Campbell, retired research engineer of the Bell Telephone Laboratories during the winter convention of the institute, which will be held in Philadelphia from January 27 to 31. The medal was awarded to him "in recognition of his distinction as scientist and inventor and for his outstanding original contributions to the theory."

AT this meeting of the institute, "Outstanding Young Electrical Engineers for 1940" will be honored at the Eta Kappa Nu award dinner, which will be held on January 27 at the Engineers Club of Philadelphia. Dr. Jesse E. Hobson, of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, is the winner of the 1940 award. Donald G. Fink, managing editor of *Electronics,* and Stuart C. Hight, of the Bell Telephone Laboratories, will receive honorable mention. P. H. Chase, chairman of the committee on awards, will preside.

THE thousand dollar prize of the American Association for the Advancement of Science, given annually during the past eighteen years to the author "of some notable contribution to science presented at the meeting," was awarded at the closing sessions of the annual convention at Philadelphia to Professor Dennis Robt. Hoagland, head of the Division of Plant Nutrition of the University of California at Berkeley, and to Dr. D. I. Arnon, also a member of the division, for their paper entitled "Availability of Nutrients with Special Reference to Physiological Aspects." Others who took part in the investigation were Dr. F. C. Steward, now at the University of London; Drs. P. R. Stout, H. Jenny, R. Overstreet and T. C. Broyer.

THE award of Phi Epsilon Pi was conferred on December 31 at its annual convention in Chicago on Dr. Albert Einstein, of the Institute for Advanced Study at Princeton, for making "the richest contribution to the essential Jewish life of America."

ROBERT MOSES, commissioner of parks for New York City, was presented on January 9, at a luncheon of the New York Advertising Club, with the bronze tablet of the club in recognition of his work on behalf of the city.

THE American Society of Naturalists at its annual meeting in Philadelphia elected the following officers for 1941: *President,* Dr. W. W. Cort, professor of helminthology in the School of Hygiene and Public

Health of the Johns Hopkins University; *Vice-president,* Dr. L. H. Snyder, professor of zoology at the Ohio State University; *Secretary,* Dr. A. C. Kinsey, Waterman research professor of zoology at Indiana University.

DR. OSWALD T. AVERY, member of the Rockefeller Institute for Medical Research, was elected president of the Society of American Bacteriologists, at the opening of its annual convention in ~~Cincinnati~~ St. Louis on December 27. Dr. Avery, who succeeds Dr. Charles Thom, of the Bureau of Plant Industry of the U. S. Department of Agriculture, is succeeded as vice-president by Dr. Selman A. Waksman, of the New Jersey State Agricultural Experiment Station, New Brunswick.

FRANK W. CALDWELL, director of research of the United Aircraft Corporation, has been elected president of the Institute of the Aeronautical Sciences and will take office at the annual dinner of the institute on January 28. He succeeds James H. Doolittle.

DEAN E. M. FREEMAN, head of the division of plant pathology and botany of the University of Minnesota and of the section of plant pathology at University Farm, has resigned from the administrative direction of the division, but is continuing as professor of plant pathology. He is succeeded as administrative director by Dr. E. C. Stakman.

DR. E. N. HARVEY, professor of physiology at Princeton University, will spend part of his time at the Massachusetts Institute of Technology as a lecturer and consultant.

THE *Journal* of the American Medical Association reports that the second Pan American Congress for Endocrinology will meet in Montevideo, Uruguay, from March 5 to 8. Among others, papers will be read by Drs. F. C. Koch, Frank P. Hixon distinguished service professor of biochemistry at the University of Chicago; Herbert M. Evans, Morris Hertzstein professor of biology and director of the Institute of Experimental Biology of the University of California, and B. A. Houssay, professor of physiology in the Medical School of the University of Buenos Aires.

H. B. FRONING has been appointed dean of the College of Science of the University of Notre Dame, Indiana, to succeed the late Francis J. Wenninger. Dean Froning continues as head of the departments of chemistry and chemical engineering.

DR. N. B. MENDIOLA, professor and head of the department of agronomy of the University of the Philippines, has been appointed director of research in the College of Agriculture.

IT is reported in *Nature* that Dr. G. Roussy, rector of the University of Paris, formerly professor of pathological anatomy and dean of the medical faculty, and M. Maurice Guyot, general secretary of the university, have been removed by order of the Vichy Government.

Nature also states that it is announced in *France,* the journal for Free Frenchmen published daily in Great Britain, that Professor P. Langevin, who has just been awarded the Copley Medal of the Royal Society, is now in prison.

LIEUTENANT-COLONEL G. S. PARKINSON has been appointed acting dean of the School of Hygiene and Tropical Medicine of the University of London and acting director of the Department of Public Health.

JAMES C. LEARY, science writer on the staff of the Chicago *Daily News* for the past several years, has been named science editor of that paper.

DR. THOMAS BARBOUR, director of the Harvard University Museum, has been appointed by the Secretary of the Interior to fill a vacancy in the Advisory Committee on National Parks, Historic Sites, Buildings and Monuments of the National Park Service. He has also been nominated by Dr. Frank B. Jewett, president of the National Academy of Sciences, and has been elected by the board of directors as the executive officer in charge of the Canal Zone Biological Area recently established by Act of Congress. Dr. Barbour was formerly chairman of the Executive Committee of the Institute for Research in Tropical America and has been in active charge of the operations of the laboratory since its establishment.

DR. JOHN G. JENKINS, chairman of the department of psychology at the University of Maryland, will serve as director of research for the Committee on the Selection and Training of Aircraft Pilots. He will continue teaching at the college for half time.

DR. DONTCHO KOSTOFF, of the Institute of Genetics of the Academy of Sciences, U.S.S.R., has joined the staff of the Central Agricultural Experiment Station at Sofia, Bulgaria.

WESTERN RESERVE UNIVERSITY has received two gifts from Commodore Louis D. Beaumont, formerly of Cleveland, now residing in Florida. The first is in the sum of $5,000 to be used for general university maintenance; the second, in the sum of $8,500, is to continue the research on hypertension being carried on by Dr. Harry Goldblatt, professor and associate director of the Institute of Pathology.

DR. IRVINE H. PAGE, director of the Lilly Laboratory for Clinical Research, Indianapolis, will deliver the Edward Gamaliel Janeway Lecture at Mount Sinai Hospital, New York City, on January 10. The sub-

ject of his lecture will be "The Nature of Experimental and Clinical Hypertension."

DR. HENRIK DAM, associate professor at the Biological Institute of the University of Copenhagen, will give the Cutter Lecture on Preventive Medicine at the Harvard Medical School on Thursday, January 30. His subject will be Vitamin K—(a) Its General Significance in Biochemistry, and (b) Its Role in Human Pathology and its Application in Therapeutics. The Cutter Lectures have been given each year since 1912.

DR. DAVID A. TUCKER, professor of the history of medicine at the University of Cincinnati, gave the annual Alpha Omega Alpha initiation address on December 13, at the Ohio State University. The lecture was entitled "The Physician in Historical Retrospect."

THE sixth International Congress for the Unity of Science will be held at the University of Chicago from September 2 to 6 in connection with the celebration of the fiftieth anniversary of the university. The program will consist mainly of symposia devoted to the discussion of central and frontier problems in the present state of the unification of scientific knowledge. Those who plan to attend or who wish to receive further notices of the congress are asked to communicate with Professor Charles Morris, University of Chicago.

THE tenth anniversary of the opening of the School of Medicine and Hospital of Duke University was celebrated, and the new Department of Neuropsychiatry was dedicated, on November 29 and 30. A hundred and twenty medical alumni and former members of the house staff were present. Dr. Adolf Meyer, Henry Phipps professor of psychiatry, of the School of Medicine of the Johns Hopkins University, gave an address entitled "Considerations on Psychiatry or Ergasiatrics as an Essential and Natural Part of All Medical Training and Practice." Special clinics and talks were given by Drs. R. L. Flowers, F. M. Hanes, D. T. Smith, Deryl Hart, Bayard Carter and W. C. Davison.

THE University of California has received a bequest of $1,000,000 under the will of the late Michael J. Connell, Los Angeles banker and philanthropist. The estate was left to the M. J. Connell Charities Company and to the University of California. Most of the property consists of buildings in downtown Los Angeles, the M. J. Connell Company, various securities and other properties. The M. J. Connell Company, which manages the estate to produce revenue for the M. J. Connell Charities Company, the university and other organizations, is conducted by a board of directors. While the bequest was made some time ago, no report could be made to the Board of Regents because under terms of the will the property was not available until recently.

DR. JOHN F. FULTON, Sterling professor of physiology at Yale University, has presented to the Yale Medical Library a collection of books and government documents bearing on military medicine published in England since the beginning of the war. There are some fifty items in all, plus a collection of Medical Research Council reports on various phases of industrial medicine. In this latter series there are some seventy titles. These collections are now available to readers in the new reading room of the General Medical Library of the Sterling Hall of Medicine.

Torreya reports that the Herbaria of the Muséum d'histoire Naturelle, Paris, which after the outbreak of the war was divided among three castles near Paris for safe keeping, is in good condition and has been returned to the museum.

A CORRESPONDENT writes to SCIENCE that owing to the national necessity for the strictest economy in paper, and in order to reduce the expense of printing and publication, the Royal Society of Edinburgh has decided that, as from vol. 61, 1940–41, the *Proceedings* shall be published in two sections, namely "A" (Mathematical and Physical—including Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology and Physics) and "B" (Biological—including Anatomy, Anthropology, Botany, Geology, Pathology, Physiology and Zoology). Fellows of the society, and institutions with which the society exchanges publications, will benefit under this arrangement by having, in smaller compass, papers dealing with the subjects in which they specialize. No change is proposed in the present form or in the arrangement for the distribution of the society's *Transactions*. The obituary notices of fellows, proceedings of meetings, list of fellows, prizes, etc., formerly published as appendixes at the end of each session's volume of *Proceedings*, will, under the new scheme, be published separately, and will be sent normally to all fellows and to those exchanges specially desiring to receive them.

DISCUSSION

THE DISTRIBUTION OF THE PERIODICAL LITERATURE OF SCIENCE

IN a recent discussion[1] of the publication of scientific research, attention was called to the disadvantages resulting from the diversity of the contents of scientific periodicals. It was suggested that some form of supervision of the range of subjects covered by the papers

[1] Seidell, SCIENCE, 92: 345–7 (Oct. 18). (This article was criticized by Dr. Richard L. Sutton, Jr., SCIENCE, 92:

published in a given journal should be exercised. Although the advantages to be gained in this manner would certainly be very great, it may well be questioned whether the necessary cooperation for such reforms could be secured even in one country, much less throughout the world. In view of this it has appeared of interest to consider whether better utilization of the literature of science might not be achieved by improvements in the means of distribution of the papers published under present conditions.

It is apparent that persons engaged in scientific research must both learn of the existence of the reports of others and have access to or be able to obtain copies of the original publications. The problem then is to satisfy these two needs in a better manner than at present.

Acquaintance with the source literature of science is usually obtained by means of abstract journals, reviews, bibliographies or the references given in each paper to preceding publications. These resources serve admirably for the prior literature but not for the currently appearing contributions. It is these that many investigators are especially anxious to have brought promptly to their attention.

In the larger research centers, such as that composed of the governmental laboratories in Washington, the system in operation is the circulation of the current issues of the journals among the workers. Each one is thus permitted to successively examine the contents of the periodicals he selects. This plan, however, has the serious disadvantage that while the journal is circulating it is not available for reference. Furthermore, each worker must peruse the copy during the brief period it is at his disposal, and may sometimes be forced to neglect more important work in order not to delay the circulation of the periodical. There is also the disadvantage that the contents of each number is usually so varied that much time may be wasted in scanning articles of no immediate interest while searching for the rare ones directly bearing upon a given problem.

A far better plan would be the publication of current classified catalogues of the titles of papers appearing in scientific periodicals. The only question is whether such publications can be produced at not too great an expense, and, when coupled with microfilm copying service, will they satisfy the needs of workers not adequately supplied with journals or abstracts.

The necessary conditions for launching such a project are adequate library collections of periodicals in given fields of science, and properly qualified persons to select and classify the titles to be included in the published catalogues. Microfilm services have been developed sufficiently to meet the needs in respect to microfilm copying. There is, however, the accompanying requirement that the journals from which microfilm copies are to be made shall not circulate.

Fortunately there is a library where all these conditions are fulfilled, and it is probable that a trial of the plan can be made there. This is the Army Medical Library of Washington. Its collections of medical periodicals are among the most complete in the world and are circulated to only a very limited extent. The Library also collects directly from the current journals the titles of the articles subsequently used in compiling its Index Catalogue of Medical Literature. The cards thus made are available for preparing at small expense a classified catalogue of the currently appearing papers. The Library is also provided with a microfilm copying service and thus combines all the elements required for inaugurating the suggested system of disseminating current periodical literature.

There is one additional question which arises in connection with the catalogues of current titles and that is whether they can also be conveniently used for searching the prior literature. For this purpose indices will be required, but their preparation need not add greatly to the expense, and with them it should certainly be possible to trace desired references to articles of which the titles have been recorded in the preceding issues of the catalogue.

It may be concluded, therefore, that this improved means of acquainting research workers with the current periodical literature, and promptly supplying them with microfilm copies of it, will enable many more persons to undertake research than can now do so with profit, and permit everyone to make better use of the published work of others for the advancement of science.

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478 (Nov. 22) on the basis that it "describes the scheme one would expect of a Totalitarian State or the U. S. S. R." Dr. Sutton overlooks the fact that the freedom of the press to which he refers has a very different purpose than the publication of scientific research for the benefit of those able to use it for the advancement of science. It is needless to mention that the purpose of my article was to call attention to the chaos which exists in the periodical publication of science and suggest that something be done about it.

VITAMIN L AND DEXTRIN DIET

IN a previous note in SCIENCE, incidental to pointing out the non-identity of vitamin L and filtrate factor, we[1] referred to Sure,[2] who stated that an attempt to rear young of the albino rats with supplements of crystalline thiamine, riboflavin, vitamin B_6, choline

[1] W. Nakahara, F. Inukai and S. Ugami, SCIENCE, 91: 431, 1940.

[2] B. Sure, *Jour. Nutrition*, 19: 57, 1940.

and nicotinic acid resulted in complete failure of lactation, and that the addition of filtrate factor concentrate prepared from liver extract resulted in success in every trial. Liver filtrate is a potent source of vitamin L_1 but, according to our previous experiments, the other necessary lactation vitamin, *i.e.*, vitamin L_2, is absent from it.[3] The question then arises: how did it happen that Sure obtained successful lactation without vitamin L_2 supplement?

Our recent experiments show that Sure's use of dextrin in his basal diet provides the answer to this question. We confirmed that more or less satisfactory lactation can be obtained on a diet consisting of dextrin 60%, purified fish protein 25%, butter 10%, and McCollum's salt mixture 5%, supplemented with acid earth adsorbate of yeast extract (vitamin B complex) and liver filtrate (filtrate factor and vitamin L_1). If, however, polished rice is used, instead of dextrin, an additional supplement of yeast constituent (vitamin L_2) becomes necessary for successful lactation, liver filtrate supplement being insufficient.

Dextrin diet + liver filtrate (L_1): 35 of 81 young reared (43.2%).
Polished rice diet + liver filtrate (L_1): 5 of 155 young reared (3.2%).
Polished rice diet + liver filtrate (L_1) + baker's yeast (L_2): 23 of 40 young reared (57.5%).

Obviously, therefore, dextrin in diet renders largely unnecessary vitamin L_2, which is absolutely indispensable in polished rice diet.

Since it is highly improbable that dextrin serves as a direct source of vitamin L_2, it may more reasonably be assumed that dextrin diet leads to the production of vitamin L_2 by the intestinal yeasts. In this connection it may be recalled that dextrin diet strikingly favors the proliferation of these yeasts which synthesize vitamin B_2, rendering the rats relatively refractory to B_2 deficient feeding.[4] In any event, it seems now clear that vitamin L_2 deficiency can not be produced by dextrin diet, and that with this diet vitamin L_1 supplement is sufficient to permit successful lactation.

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FUMITO INUKAI
SABURO UGAMI

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AN INVESTIGATION OF GROWTH IN PLANTS

A RECENT grant from the Rockefeller Foundation to the Connecticut Agricultural Experiment Station will be used to further a study of normal growth that has been in progress for some time. The long inbred strains of maize that have been continuously self-fertilized for more than 30 generations furnish favorable plant material for an investigation of this kind. These inbred plants are so reduced in size and growth rate and so uniform in all structural details that any mixing with unrelated plants can be certainly detected. In this material heritable changes are occurring from time to time that are known to have their origin in the nucleus. Most of these are degenerations from a normal level of vigor.

Chromosomal rearrangements, both spontaneous and induced, are known to alter growth in the endosperm tissue. The problem is to study their effects upon other parts of the plant where they can be measured statistically.

The interaction of nucleus, cytoplasm and cytoplasmic inclusions in the control of normal growth and differentiation is one of the most fundamental problems in biology at the present time. Knowledge in this field has importance for the further improvement of economic plants and animals and the control of neoplastic diseases.

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PRO AND CON EVOLUTION IN CONTEMPORARY GERMANY

FASCICULE 4–5 of Volume 37 of the semi-scientific periodical *Natur und Kultur* of Muenchen (April-May, 1940) contains an editorial preface by Dr. Franz Wetzel and nine essays by different authors, in all of which are to be found violent attacks upon evolution, especially with regard to the origin of man from apelike ancestors.

It is not intended here to discuss the arguments assigned in those essays, based chiefly on Dacqué's and Westenhöfer's ideas, but attention must be drawn to a fact most striking to a scientific reader: nowhere are the conclusions derived from the results of research; on the contrary, the former are tested as to whether or not they agree with the national socialist racial theory ("Rasselehre"). If they do not they have to be rejected. Evolution seems to be especially suspect because it appears to be contradictory to the invariability of species and races, required as dogma by the "Rasselehre," and is, in consequence, stigmatized by Otto Muck[1] as "Theorie der universalen Art- und Rasselosigkeit." It is no less striking to see that the adversaries of evolution reproach its advocates, alleging that the latter make them politically suspect.

Fortunately, H. Weinert rejects all these anti-evolutionary arguments as "pseudowissenschaftliche Ein-

[3] W. Nakahara, F. Inukai and S. Ugami, SCIENCE, 87: 372, 1938.
[4] N. B. Guerrant and R. A. Dutcher, *Jour. Biol. Chem.*, 110: 233, 1935; U. Tange, *Sci. Pap. Inst. Phys. Chem. Research*, 36: 471, 1939.

[1] *L.c.*, pp. 133, 135.

wände gegen die menschliche Abstammungslehre,"[2] but even he[3] endeavors to support his scientific opinion politically, asserting that, should the origin of man be questioned, the adversaries of the national socialist "rassenhygienische" tendencies could cite the uncertainty of science.

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SCIENTIFIC BOOKS

GEOMETRY OF CURVES AND SURFACES

Metric Differential Geometry of Curves and Surfaces. By ERNEST PRESTON LANE, professor of mathematics, University of Chicago. Pp. viii + 216. Chicago: The University of Chicago Press. 1940. $3.00.

THIS book is quite elementary in character. Plane, analytic geometry and the usual first-year course in calculus are sufficient prerequisites. In addition some knowledge of three-dimensional analytic geometry (direction cosines, equations of straight lines and planes in space, etc.) will be helpful, but this can be developed as the need arises in any class using this book as a text.

As mentioned in the preface by the author, most of the material included is classic. Consequently, the scope of the book is perhaps sufficiently well indicated by an enumeration of the chapter headings with a few additional comments. Chapter I, "Curves": This includes a discussion of arc length, curvature, torsion, the osculating sphere and circle and the Frenet formulas. Chapter II, "The Moving Trihedron," contains an application of the moving trihedron to such topics as involutes, evolutes, parallel curves and Bertrand curves. Chapter III, "Surfaces": Here the first fundamental form is introduced, the envelopes of surfaces, developable surfaces and ruled surfaces are considered. Chapter IV, "Curves on Surfaces": This contains a discussion of such topics as minimal curves, asymptotic curves and the second fundamental form, conjugate nets, lines of curvature and geodesics. Chapter V, "Curvature": This includes among other topics the radius of normal curvature, principal normal curvatures, geodesic curvature and geodesic torsion. Chapter VI, "Transformation of Surfaces," contains a discussion of conformal representation, applicability and parallel surfaces.

The reviewer was very favorably impressed by the simple and easily understandable style in which Professor Lane has written this book. An important and very desirable feature of the book is the abundance of definitions. By encouraging students to reason upon carefully worded definitions, Professor Lane has performed an essential mathematical service. Definitely stated theorems expressing the results obtained are also much in evidence throughout the book. In these respects Professor Lane is strongly to be congratulated.

In the opinion of the reviewer, if this book were used as a text in an undergraduate class composed of students who have completed their first or second course in calculus, it would constitute an interesting application of their previous mathematical work and be a source of inspiration toward further mathematical activity. But in the preface Lane states that the book is designed as a text for first-year graduate students. Here the author and reviewer are in decided disagreement and as the matter is an essential one the reviewer would like to make his position clear.

The book is essentially "undergraduate" in character. For example, in the very first sentence of the book (p. 1) we find ". . . curves and surfaces in ordinary three dimensional space." Now this is the way we speak to undergraduates. When a student has entered upon graduate work (and this includes presumably only such as are genuinely interested in the subject) he will ask what is "ordinary three dimensional space" in the mathematical sense. He will ask this question and he will be entitled to an answer. But he will not find the answer in Lane's book. Again in deriving the formula for the arc length of a curve (equation (3.6) on p. 8) we find that the arc length Δs appears in the derivation. Surely a graduate student is entitled to have this formula (which in reality defines the arc length) presented to him in such a way that the concept of arc length is not inherent in the derivation. No doubt other such objections could be found, but the reviewer has not sought them, and they are mentioned here only as an indication of the "undergraduate spirit" in which this book is written.

But the main objection to this book as a graduate text lies in another direction. The subject of tensor analysis can best be introduced and illustrated as part of a course on differential geometry. Moreover, the ideas and methods of the tensor analysis enter basically in the theory of relativity, are useful in the calculus of variations, mechanics, hydro- and aerodynamics and have appeared in certain phases of such widely divergent fields as engineering and topology. In the opinion of the reviewer one should continually seek in graduate instruction to enlarge and enrich the viewpoint of the student and in failing to base his text on the invariant formulation of the tensor analysis Professor Lane has lost not merely an excellent opportunity to introduce his readers to a point of view useful in other fields

[2] *Verhandl. d. Deutsch. Ges. f. Rassenforschg.*, Vol. X, Sonderheft, 1940, pp. 96–99.

[3] *L.c.*, p. 98.

of mathematical work but has deprived them at the same time of a type of analysis which forms in fact a necessary mode of presentation of the underlying concepts of differential geometry itself. For these reasons the reviewer does not consider this text desirable for graduate instruction in any American university.

The binding and printing are excellent, and the University of Chicago Press is to be congratulated for its part of the work.

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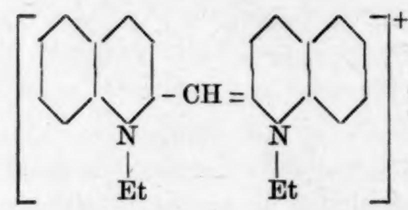
SPECIAL ARTICLES

THE STRUCTURE OF THE MESOMORPHIC PHASE OF CERTAIN CYANINE DYES

BASED partly on extensive work to be presented by the writer and colleagues, a structure is proposed for the aggregated phase of *di-ethyl-ψ-cyanine* and related dyes which give a remarkable new absorption (and fluorescence) band. Discovered by E. E. Jelley[1] and independently by G. Scheibe,[2] it is convenient to term it a Z-band, and the corresponding aggregation of the dye, a Z-state.

On silver halides[3] the dye cations are adsorbed edge-on at the ionizable hydrophile (ventral) aspect of the planar molecule. The counter-ion is furnished by the silver halide lattice. At high adsorption densities the dye cations form packets of parallel ordered molecules, like card-packs, but with an interval of ca 3.7 Å between adjacent cations. These "card-packs," but with an important modification, are regarded as constituting the separately sensitizing dye "aggregates" of Leermakers, Carroll and Staud[4] and the "nematic" filaments discovered by Jelley in aqueous suspension. From optical observations Jelley showed that the new absorption band corresponds to a light vibration *parallel* to the axis of the filament, and in the z-axis of the resultant crystal. In our model thus far presented this means a light-vibration perpendicular to the planes of the units of the card-packs. Conclusions similar in essentials were reached by Scheibe,[5] but from adsorption experiments on mica he considered that alternate parallel molecules are staggered. He has suggested that the forces orienting and holding the units in parallel apposition are inductive forces of the p-electrons of the (heterocyclic and aromatic) nuclei and of the chain joining these. The structure proposed here postulates a very different type of linkage, *viz., water molecules,* coordinated intermolecularly between *opposite* terminal nitrogen atoms of the parallel resonance chains. A reversible effect of moisture on the production and disappearance of the Z-band for ψ-cyanine adsorbed to silver bromide was observed by Leermakers, Carroll and Staud,[4] and confirmed by Sheppard, Lambert and Walker;[3] the fundamental importance of water for the Z-state of unadsorbed dye has been shown by Jelley[6] and equally recognized by Scheibe.[5]

The ψ-cyanine has the formula:

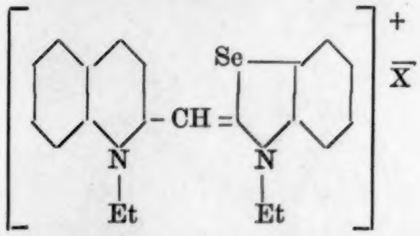


where $\overline{X}$ is a univalent anion, and the large cation derives its positive charge from the resonance hybrid between states having each N-atom alternately in the quaternary state. We will symbolize such a molecule as $N_p \sim N_p$, where the subscript represents the nuclear portion (and *its electromeric effect*) and is changed accordingly. Thus for a non-symmetrical cyanine we may write $N_{p'} \sim N_{q}$, where p' denotes the same nucleus as p, but changed because joined with q. In the Z-state we supposed these cations arranged in parallel, and between each successive opposite pair of molecules at least one water molecule—H_2O—coordinated between each pair of opposite N-atoms. Any adjacent pair of dye molecules form a cell or doublet; in the extended filament $(N_p \sim N_p)n$, where n is the number of cells, if there are just two H_2O molecules per cell, the ratio of H_2O/dye molecules will vary from 1:1 for $n=1$ to 2:1 for $n=\infty$ and similarly for other basic H_2O values per cell. These interstitial "hydrate" molecules furnish the mobile electrons permitting (in the ground state) inter-molecular or cross-resonance between the N-atoms of adjacent molecules, which evidently must be coupled, or in phase relationship, with the intramoleculer resonance of the component dye molecules. Hence, a condition of alternation or pulsation will obtain between successive adjacent cells, which is important as permitting undamped transfer of excited states throughout a filament. *These intermolecular resonance linkages through "hydrate" water molecules are supposed to furnish the characteristic*

[1] E. E. Jelley, *Nature,* 138: 1009, 1936; *ibid.,* 139: 631, 1937.
[2] G. Scheibe, *Angew. Chem.,* 50: 51, 1937.
[3] S. E. Sheppard, *Atti. X. Congress Internat. Chim.* (Rome, 1938, V. I. pp. 235–283; S. E. Sheppard, R. H. Lambert and R. D. Walker, *Jour. Chem. Phys.,* 7: 265, 1939.
[4] J. A. Leermakers, B. H. Carroll and C. J. Staud, *Jour. Chem. Phys.,* 5: 878, 1937.
[5] G. Scheibe, *Koll. Zeitschr.,* 82: 1, 1938; *Angew. Chem.,* 52: 631, 1938.
[6] Unpublished work, these laboratories.

Z-band on excitation by light. The particular electron distribution in water molecules[7] is believed to lend itself to this and other participation of "hydrate" water in light absorption.

From the necessary alternation of "inactive" and "active" cells, the band intensity will grow with length of filament, but the characteristic frequency or wavelength will not change. Thus the structure behaves like the *meta*-bonded rather than the *para*-bonded polyphenyl.[8] Symbolizing such a cross-resonance by $N_p \times N_q$ the frequency, intensity and purity (sharpness) of the Z-band will depend upon p and q, hence on the actual structure of the component molecules, because the *basicity* of the related N-atoms is determinative.[9] For example, the dye *di-ethyl-ψ-selena-cyanine* was found by Scheibe[5] to give a Z-band. But



compared with that of the *symmetrical* ψ-cyanine it was relatively weak and diffuse and at shorter wavelength. This is predicated on the structure proposed. The non-symmetrical ψ-cyanine, when ordered in a Z-state, can give, according to the apposition of the molecules in the cells, *three* intermolecular bands, *viz.*, $N_{p'} \times N_q$, $N_{p'} \times N_{p'}$, and $N_q \times N_q$. Hence the observed band is relatively broad and weak. Lower intensity can be predicated also with asymmetric dyes because parallel paired identical intermolecular transitions are not possible. This condition, as shown by R. S. Mulliken[10] in molecular spectra (*e.g.*, H_2 molecule) makes for great intensification. On the structure proposed, a mixture of two dissimilar but pairable dyes can give, in addition to their own iso-molecular cells or doublets, hybrid doublets and two new related Z-bands, *e.g.*, with ψ-cyanine and the ψ-selena-cyanine, $N_p \times N_{p'}$ and $N_p \times N_q$. This is the interpretation of Scheibe's important observation with these two dyes; he found with mixtures a series of intermediate bands which could not be compounded by simple superposition of the 100 per cent. bands. Actually, his data show definite breaks in the neighborhood of 1:1 molecular composition, but such breaks might occur at other proportions, depending upon the degree of hybrid doublet formation in the filaments.

Scheibe has objected to Jelley's "nematic phase" from evidence that the Z-state occurs independently of the anion. However, not only has Jelley[6] obtained definite evidence of anion influence, but our conductivity data indicate disappearance of anions in the Z-state. The structure now proposed indicates a new type of nematic phase, constituted of plurimolecular filaments instead of elongated molecules. Similar mesomorphic phases may occur with other dyes than the cyanines, *e.g.*, with the porphyrins and phthalocyanines. With these, however, intermolecular hydrogen bridges bonding key atoms seem more probable, with different conditions for intermolecular resonance.

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[7] J. D. Bernal and R. H. Fowler, *Jour. Chem. Phys.*, I: 515, 1933.

[8] *Cf.* A. E. Gillam and D. H. Hey, *Jour. Chem. Soc.*, p. 1170, 1939.

[9] L. G. S. Brooker, R. H. Sprague, C. P. Smyth and G. L. Lewis, *Jour. Am. Chem. Soc.*, 62: 1116, 1940.

[10] R. S. Mulliken, *Jour. Chem. Phys.*, 7: 32, 1939.

ASSOCIATION OF PHOSPHATASE WITH A MATERIAL IN KIDNEY SEDIMENTABLE AT HIGH SPEED AND ITS LIBERATION BY AUTOLYSIS[1]

Extracts of many normal and tumor tissues have been shown to contain large amounts of material which can be sedimented in the ultracentrifuge at 27,000 r.p.m. for one hour. The viruses of fowl leukosis and sarcoma[2,3] substances showing cytochrome oxidase and succinic dehydrogenase[4] activity, the heterogenetic, tissue and organ specific antigens,[5,6] have been shown to be associated with this fraction.

The effect of autolysis on tissue extracts was studied in an attempt to obtain information on the relation of the heavy fraction to biologically active constituents of tissues which are of much lower molecular size. Kidney phosphatase was selected because it is usually prepared from autolyzed tissues and is extremely stable in solution.

Kidneys from ten mice were divided into two equal parts. One part (A) was allowed to autolyze at room temperature for a week with 20 volumes of distilled water and a small amount of toluene. The other part (B) was kept frozen at $-60°$ until the first half was autolyzed. It was then ground with sand and 20 volumes of distilled water and toluene. Sodium chloride was added to both solutions to make a final concentration of 0.9 per cent., and the material was centrifuged in the cold and at 8,000 r.p.m. for 15 minutes. These crude extracts were centrifuged at 27,000 r.p.m. during one hour, the supernatants decanted, and the sediments resuspended in the original volume of saline.

These fractions from autolyzed and non-autolyzed

[1] This investigation was supported by grants from the Anna Fuller Fund and the Jane Coffin Childs Memorial Fund for Medical Research.

[2] E. A. Kabat and J. Furth, *Jour. Exp. Med.*, 71: 55, 1940.

[3] A. Claude, Science, 90: 213 ,1939; 91: 77, 1940.

[4] K. G. Stern, Cold Spring Harbor Symposia on Quantitative Biology, 7: 312, 1939.

[5] J. Furth and E. A. Kabat, Science, 91: 483, 1940.

[6] W. Henle and L. A. Chambers, Science, 92: 313, 1940.

tissue were analyzed for nitrogen, complement fixing power to tissue specific (Ts) and heterogenetic antibodies (F), and phosphatase activity. The latter was determined under optimal amino acid and magnesium concentration, as described by O. Bodansky,[7] at several slightly different pH to obtain the maximum activity. Phosphatase activity $Q_{0.05}$ is the reciprocal of the time in minutes necessary to liberate 0.05 mg P per ml of solution. The phosphatase activity of each crude extract was arbitrarily considered as 100 per cent.

this large particle would provide a structural form within the cell which may influence the sequence and direction of enzyme reactions.[8]

Summary: Phosphatase in extracts of mouse kidney is associated with the material sedimentable at 27,000 r.p.m. for one hour. On autolysis, this fraction decreases in amount, phosphatase is liberated, and the tissue specific and heterogenetic components are destroyed.

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TABLE 1

	(A) Kidney autolyzed for 1 week					(B) Kidney ground with sand in cold				
	N/ml	Highest dilution giving complement fixation		Phosphatase activity		N/ml	Highest dilution giving complement fixation		Phosphatase activity	
		Ts	F	$Q_{0.05}$	%		Ts	F	$Q_{0.05}$	%
Experiment 1	(2.16 gm kidney used)									
Crude extract	0.71	0	0	.0526	100	0.79	1/5	1/5	.0167	100
27000 supernatant		0	0	.0526	100		0	0	.0072	46
% high speed sediment	2.8 per cent.					15.8 per cent.				
Experiment 2	(1.11 gm kidney used)									
Crude extract	0.60	0	0	.074	100	0.86	1/9	1/3	.0222	100
27000 supernatant		0	0	.074	100		0	0	.0052	26
Resuspended high speed sediment		0	0	0	0		1/9	1/4.5	.0164	82
% high speed sediment	3.3 per cent.					12.0 per cent.				
Experiment 3	(3.3 gm kidney used)									
Crude extract	0.69	1/9	0	.0394	100	0.77				
27000 supernatant		0	0	.0358	91		1/27	1/3	.0312	100
Resuspended high speed sediment		1/9	0	.0078	20		0	0	.0036	12
% high speed sediment	4.4 per cent.					13.7 per cent.	1/27	1/3	.0264	85

Table 1 shows that in tissue extracts (B), the phosphatase activity is sedimented with the tissue specific and heterogenetic antigens. Autolysis of the tissue (A), however, causes a decrease in the amount of the heavy fraction, loss of complement fixing power to both the tissue specific and the heterogenetic antigens, with the liberation of the phosphatase in an active nonsedimentable form. Loss of complement fixing power and liberation of phosphatase from the heavy fraction seem to parallel each other. Thus in experiment 3A some tissue specific antigen remained after autolysis and a small amount of sedimentation of the phosphatase activity was found. Since some autolysis occurs even in the cold, it is not surprising that all phosphatase can not be sedimented in the non-autolyzed extracts (B). When the procedure is carried out more rapidly (within 6 hours) (experiments 2B and 3B), a much larger part of the phosphatase sediments than if carried out more slowly (over 2 days) (experiment 1B).

The association of enzymes of low molecular weight, such as phosphatase, with particles several hundred times larger in size, suggests that this heavy fraction may play an important role in the cell by acting as a carrier for certain biologically active substances. Attachment of different enzymes at various sites on

[7] O. Bodansky, *Jour. Biol. Chem.*, 118: 341, 1937.

[8] I. M. Korr, Cold Spring Harbor Symposia on Quantitative Biology, 7: 74, 1939.

THE INADEQUACY OF SYNTHETIC DIETS FOR MICE

DURING an investigation on vitamin E and experimental tumors,[1] it was found that strain A males (Bar Harbor) developed edema and protrusion of the eyeballs on a diet supposedly adequate, save for vitamin E. The basal diet (C) consisted of casein 31, corn starch 28, lard 21, salt mixture 7, cod liver oil 3 and yeast 10. Two years ago experiments were started to determine, if possible, the cause of the edema and eye condition. In the first experiment, strain A males, 4 to 5 weeks old, were placed upon diet C and divided into three groups. One group received the basal diet alone, one group received the basal diet plus the oral administration of .5 mg ascorbic acid (Eastman) three times weekly, and the final group received 30 mg of a tested vitamin E concentrate every two weeks. Ten mgs of this E concentrate would insure pregnancy in E deficient strain A females. The growth and physical appearance of the mice were excellent until the mice reached the age of 8–12 months. At this time the following symptoms occurred: sore eyes, uni- or bilateral, characterized by swelling and inflammation of the eyelids leading to closure of the eyes and blindness

[1] C. Carruthers, *Am. Jour. Cancer*, 35: 546.

in many cases, dermatitis on the ventral aspect of the neck between the forelegs and extending up almost to the lower lip, and some loss of hair especially on the face and neck. All these symptoms were followed by death.

On diet C the females showed the same symptoms about one month later than the males. However, the former showed the same phenomena in a large number of the mice as early as 7 months on the following diet (D): casein 31, sucrose 28, rancid lard 21, salt mixture 7, cod liver oil 3 and yeast 10 or 15. The cod liver oil was mixed with the other constituents just before feeding. The oral administration of cod liver oil three times weekly or of hydroquinone 5 mg three times weekly from the time of weaning failed to prevent the occurrence of the symptoms. Those receiving a tested vitamin E concentrate showed the disease somewhat later.

The following changes in diet C have not resulted in curing the symptoms nor have they prevented them when instituted at the time of weaning (the changes were made at the expense of the starch, and the diets were stored at 0° C.): yeast 15% and cod liver oil 5%; yeast 15%, cod liver oil 5% and casein 18%; yeast 15%, cod liver oil 5% and salt mixture 8%, 7% and 4%; in the female yeast 10% and cod liver oil 5%. The following substances have been ineffective in preventing the fatal outcome: vitamin A concentrate in the natural ester form, cod liver oil, ether extracted wheat germ oil, tested vitamin E concentrate, vitamins B_1 and B_6, riboflavin, nicotinic acid (.5% in diet C), alfalfa meal (10% and 20% in diet C), choline, lemon juice (entire lemon) and tomato juice. Mice were placed on the modified diets or given the various supplements when the deficiency was manifest by swelling and inflammation of the eyelids.

Purina Dog Chow and Rockland Mouse pellets prevented death and brought about apparent cure in most of the deficient mice in 4 to 6 weeks. A small percentage was resistant. Many natural foodstuffs have been incorporated into diet C at 10% and 20% levels and, up to now, fresh flaked wheat germ and aqueous liver extract were found to have the most potent curative properties. But under the experimental conditions observed by us so far, it has not been possible to obtain a 100% recovery with these two materials. A percentage varying from 40% to 60% died or was not completely cured, thus indicating either that the damage, if too extensive, is irreparable, or that the substances now tested are not the most potent. These observations would seem to indicate that a real deficiency exists for quite some time before it becomes apparent, thus making complete cure difficult. The substances showing curative properties, and others are now being tested both as preventives and curatives.

This work indicates a true nutritional deficiency disease for mice, since the symptoms are not observed in mice on stock diets nor do rats show these symptoms on similar diets. Over 1,100 mice have been used in these experiments and the regularity of the symptoms followed by the fatal outcome, unless the mice are removed from the synthetic diets, is further evidence that a deficiency exists. New Buffalo (Simpson) and Old Buffalo mice show the same symptoms on the same diets. Recently Woolley[2, 3] has shown that inositol or its derivatives are required by the mouse for normal growth and hair. Also Norris and Hauschildt[4] have found that the mouse requires a water soluble fraction of the vitamin B complex for growth and healthy skin.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR MEASURING MICROSCOPIC OBJECTS

In studies on bovine anaplasmosis, it was found desirable to measure the anaplasms or marginal bodies occurring in the erythrocytes of infected cattle. These bodies measure less than 1 micron in diameter and an ordinary ocular micrometer disc is not divided into sufficiently small units to give the accuracy needed. Difficulty was experienced in using a camera-lucida and the ordinary scale drawn on paper because the markings were so close together that it was necessary to use intense illumination on the scale in order to see the rulings in the camera-lucida. As a result, the limits of the image of the object to be measured were not well defined.

In order to avoid these difficulties and measure in tenths of a micron with reasonable accuracy, an apparatus (Fig. 1) was devised to replace the ordinary measuring scales. A microscope was fitted with a monocular tube, an oil immersion lens, a 15 × ocular, and a camera-lucida from which the mirror had been removed. A box 2 feet square and 1 foot deep was fitted with 4 electric lights and placed about 10 feet away from the microscope in a lateral direction. The open side of the box was turned toward the opening in the side of the camera-lucida and was covered by a large piece of cardboard in which the scale had been

[2] D. W. Woolley, *Jour. Biol. Chem.*, 136: 113.
[3] D. W. Woolley, Science, 92: 384.
[4] E. R. Norris and J. Hauschildt, Science, 92: 316.

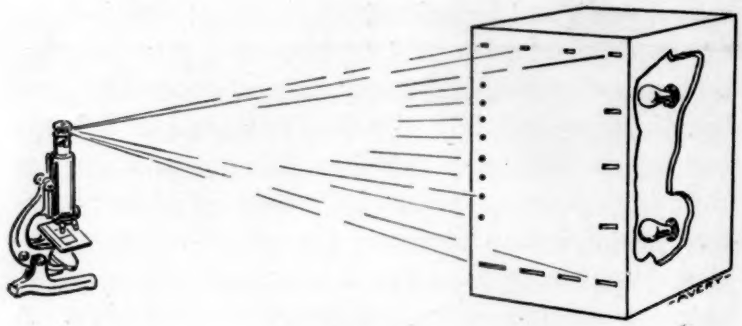

FIG. 1

made. For measuring in tenths of a micron, the scale consisted of a series of slits 1 mm in width and of various lengths. The length of each slit was calibrated so that the length of its image as seen through the camera-lucida corresponded to the length of the image of an object of known size when the object was placed on the stage of the microscope. The scale for reading in microns was made up of holes spaced at proper intervals along a line.

A stage micrometer was used to determine the proper lengths of the slits for reading in tenths of a micron, and for determining the proper spacing of the holes for the micron scale. To accomplish this calibration, the light-box was covered with a piece of cardboard upon which two points were determined to coincide with the images of two rulings on the stage micrometer when viewed through the camera-lucida. Using the known distance between these two points on the cardboard as a standard, the relative lengths for the slits desired were determined by subdividing the distance between the points with a pair of dividers. In making the slits as accurate as possible, holes were first made in the cardboard and the sides of the slits formed by strips of paper pasted over the edges of the holes.

In measuring with the apparatus, the object to be measured was moved about on the stage of the microscope and the dimensions of its image were compared with the lengths of the light-bars seen through the camera-lucida. Since the length of each light-bar represented a known value in tenths of a micron, readings were made direct.

While this apparatus was designed to measure anaplasms, which are less than 1 micron in diameter, it could well be adapted for measuring other microscopic objects. In order to facilitate the measuring of other than spherical objects, it is advisable to use either a microscope equipped with a rotating stage or to design the scale so that it can be rotated, in order to orient the object to be measured with respect to the appropriate light-bar or hole.

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A SIMPLE DUPLICATOR FOR LABELING SLIDES

THIS duplicator (see Fig. 1) operates on the principle of the mimeograph. It may be made by gluing a thick layer of felt on the flat surface of a block of wood and covering it with a fine meshed cloth fastened to the sides of the block. Mimeograph ink is applied

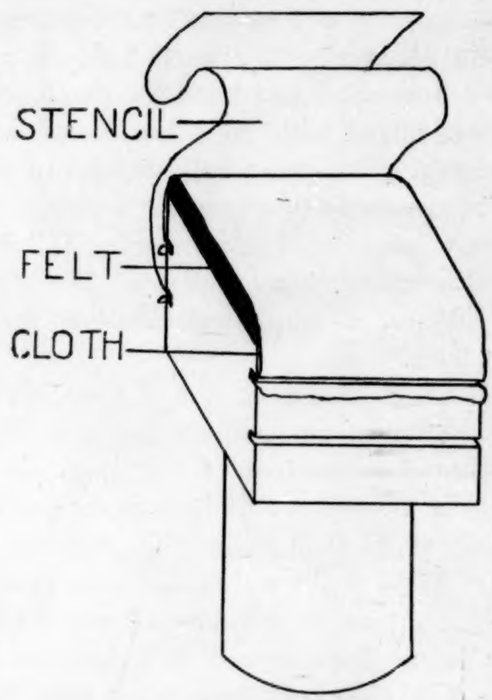

FIG. 1.

to the pad with a brush. A mimeograph stencil of desired size is typed or cut with a sharp stylus and fastened over the surface of the pad. In addition to print, descriptive sketches may be included in the label. The printing is done by touching the duplicator lightly to the surface of the label either before or after the label is pasted on the slide. Excess ink should be removed with a blotter inasmuch as only a limited amount of ink is absorbed by the label. As many as two hundred labels may be printed without reinking. The method may be employed for printing small specimen labels, blanks for collection data, etc. Larger pads may be used for other similar purposes.

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